INSIDE JEB

Free-loading swifts ride the air

A swift in free flight. Photo credit: Emmanuel de Margerie.

Once an adult swift (*Apus apus*) leaves its breeding colony and takes to the air migrating south, it won't touch down again until returning home to nest 10 months later. 'Common swifts are exceptional in their level of adaptation to aerial life', says Emmanuel de Margerie, a biologist from the CNRS (Centre National de la Recherche Scientifique) at the University of Rennes, France, adding, 'Foraging, sleeping, preening and all other daily activities are performed in mid-air, day after day, week after week'. So, when de Margerie decided to learn how the expert aviators manoeuvre in their aerial domain, he contacted biomechanist Tyson Hedrick from the University of North Carolina at Chapel Hill, USA, who snapped up the opportunity. 'Their basic flight capabilities have been well studied in wind tunnel experiments', says Hedrick. However, birds in wind tunnels never share the sky with others or contend with unexpected gusts of wind. de Margerie had filmed swifts soaring and swerving while foraging to feed their chicks and the movies provided the ideal opportunity to find out how much exertion it takes to keep an acrobatic swift on the wing in real life. But the unique footage was not collected with a conventional camera.

Mounting a pair of angled mirrors either side of a camera, with a third mirror in front of the lens to collect the reflections from the wide-set mirrors, de Margerie was able to film a pair of simultaneous movies – each from a slightly different perspective – which he could then analyse to perfectly reconstruct individual swift motions in 3D. 'The current device is cumbersome', says de Margerie, admitting that it takes time to learn how to track the swifts' tortuous flight paths. 'After some training, our undergraduate student Cécile Pichot was the most skilful at continuously following foraging swifts for relatively long flight times of up to 6 minutes', he says.

Pichot and de Margerie then painstakingly reconstructed each flight and measured various details, ranging from the position of the swifts' wings to the amount of time spent flapping, before passing the information on to Hedrick. He then calculated each bird's instantaneous speed, in addition to the *g*-force that they pulled while turning corners and the amount of energy required to power each manoeuvre. 'Digesting this dataset into relevant, comparable results, while retaining the rich information present only in natural conditions was probably the hardest challenge of the study', says de Margerie.

Impressively, the swifts spent the majority of their time gliding (71%), despite swooping and whirling around as they snapped insects from the air. And when Hedrick analysed the birds' acceleration as they turned corners, he was intrigued that the manoeuvres were relatively sedate, pulling only 1.4 *g*, compared with the high acceleration turns (8 *g*) performed by cliff swallows – probably because the insects upon which the swifts dine move relatively slowly as they are carried in the breeze.

However, when Hedrick evaluated how much energy the tiny aerial hunters consumed while darting through the air, he was astonished that they were essentially riding air currents and thermals for free. 'Thermals act like an elevator for the bird', says Hedrick, describing how vultures routinely hitch rides on the rising columns of air to swoop at high altitudes. 'Scaling arguments led earlier researchers to believe that it [riding thermals] would be less useful to small birds like swifts', he says. Yet, here were the swifts extracting energy from the air almost as effectively as vultures. 'I cannot express just how surprised we were', smiles Hedrick.

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Hedrick, T. L., Pichot, C. and de Margerie, E. (2018). Gliding for a free lunch: biomechanics of foraging flight in common swifts (*Apus apus*). *J. Exp. Biol.* **221**, jeb186270.

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